the Darts in Figure) and puſhes back the Light ſo as to reflect it when the Vibration is contrary to its Direction, but brings it down to be refracted when the Vibration conſpires with the ſaid Motion. *See a further Account of this in Sir* Iſaac Newton's *Opticks*, Book II. Part 3. Propoſition 12.

The Perſons preſent at the Experiments above-mentioned, tried them as well as myſelf, and being ſatisfied with the Succeſs of them, allowed me to mention it, and make uſe of their Names in this Account.

Of the ROYAL SOCIETY.

Sir *Hans Sloane*, Preſident.
Dr. *Scheutzer*.
Mr. *Grey*.
Mr. *Georges*.
Mr. *Dugood*.

Other GENTLEMEN.

Colonel *Spotſwood*.
Mr. *Haily*.
Mr. *Graham*.
Mr. *Hewet*.

FOREIGNERS.

The Abbot *Lercari*, a Nobleman of *Genoa*, Couſin to Cardinal *Lercari*.
The Abbot *Cuzzoni*.
The Abbot *Rolli*, and his Brother.

III. *The*

III. *The Method of making* Tin-Plates, *extracted from the Memoirs of the Academy of Sciences, for the Year* 1725, *by* William Rutty, *M. D. R. S. Secr.*

THE making of Tin-plates, or Lattin, as it is called, being not commonly practiſed in *England*, though there is ſo great a Conſumption of it, either becauſe the Method is not ſufficiently known, or becauſe that in Uſe to make ſmall Quantities for particular Purpoſes is much too dear to anſwer the Artificer's Expectation in making larger, whereby we are obliged to export our own Tin to *Germany*, to receive it back again *manufactured*, I thought it not improper to lay before the Society the Method the *Germans* themſelves make uſe of, as I have extracted it from a Diſſertation of Mr. *De Reaumur*, printed in the laſt Volume of the Memoirs of the Academy of Sciences of *Paris*, in which alſo he lays down ſome Improvements, as he thinks, of his own.

He takes notice then that the making of Tin-plates, (which is called in *France*, *white Iron*) does not properly begin, till they go about to prepare the Leaves or Plates of Iron that are to be tinned, which are ſuppoſed to be ſufficiently thin and flat, and cut into Squares: But there are only certain Sorts of Iron which can be reduced into theſe Leaves, of which thoſe are the moſt proper, that when heated are eaſieſt extendible, and yet can be forged with a Hammer when cold; the more ſoft and extremely flexible, as well

well as the more brittle being to be rejected. Theſe Leaves are drawn from Bars of Iron, about an Inch ſquare; which being made a little flat, they cut into thin Pieces or Soles (*ſemelles*) which they fold together, and having made them into Parcels containing forty Leaves each, beat them all at once with a Hammer that weighs from 600 to 700 ℔ Weight. After this, the principal Part of the whole Art is to prepare theſe Leaves; for the lighteſt Duſt, or the leaſt Ruſt upon their Surface will prevent the Tin from uniting with them. This may indeed be taken off by filing, but that being much too expenſive, the ſame may be brought about by ſteeping the Plates in acid Waters, for a certain Time, to what Number they pleaſe, and when they are taken out, ſcouring them with Sand, in order to fetch off any Thing that may remain upon the Surface: And by this Method a Woman may clean more Plates in an Hour, than the moſt expeditious Workman can file in many Days. Of theſe Waters the Author mentions ſeveral; but what the *Germans* themſelves uſed, and which they make a mighty Secret of, he found to be only common Water made eager with Rye, which requires very little Pains. For after they have ground the Grain groſly, and pounded it, they leave it to ferment in common Water for a certain Time, and with a little Patience they are ſure to have an eager Menſtruum. With this Menſtruum they fill Troughs or Tuns, into which they put Piles of Iron Plates; and to make it grow eager the better, and to have more Activity, they keep theſe Veſſels in Vaults or Stoves which have little Air, and in which they keep lighted Charcoal. The Workmen go into theſe Vaults once or twice in a Day, either to turn the Plates

Plates that they may be equally expoſed to the Action of the acid Liquor, or to take out thoſe that are ſufficiently cleanſed, or to put others in their room: And as the Liquor is more acid, or the Heat of the Vault or Stove is more intenſe, the Plates are ſooner cleanſed; but it requires at leaſt two Days, and ſometimes a great deal more. This is the Method which the *Germans* employed in the Tin-works in *France*, conſtantly made uſe of to prepare the Iron-plates to receive the Coat of Tin: But as the Author obſerved, that the conſtant Attendance upon them in the Stoves was very laborious, the Heat therein being almoſt inſupportable to thoſe who are not uſed to it, he propoſes ſome other Methods which are attended with very little Trouble, and as ſmall, if not a leſs Expence; and which upon Trial ſucceeded full as well. Having therefore obſerved that the Iron-leaves or Plates are covered with a Scale or Layer, half vitrified by the Fire, on which Acids have none or very little Effect, he imagined that inſtead of *diſſolving* the Iron in theſe acid Waters, it would be better to make it *ruſt*, and thereby put it in a Condition to be eaſier cleanſed from theſe Scales; as Ruſt is accompanied with a ſort of Fermentation and Rarefaction, and the Matter which ruſts takes up a greater Space, and raiſes up whatever oppoſes it. To this Purpoſe he ſteeped Iron Plates in different eager Menſtruums, as in Water in which Alum, common Salt and Sal-armoniack were ſeparately diſſolved; and others of the ſame Iron he only dipped into the ſame Waters, and inſtantly taking them out expoſed them to the Air. Theſe latter were ruſted by all of them, but ſooner by that in which the Sal-armoniack was diſſolved. After two Days, during which every Plate had been dipped

ped into the Menſtruum but twice or thrice, he ſcoured them, and likewiſe thoſe he had left to ſteep for that Time; and comparing them together, found that thoſe, which had been only wetted at different Times, cleanſed better than thoſe which were ſteeped; the Ruſt covering all the Surface of the latter without raiſing the Scale; whereas in the former, as ſoon as one Part of the Metal is detached, it is attracted by the Menſtruum, and the Surface is raiſed into Bliſters of Ruſt. Theſe Diſſolvents, the Author takes notice, tho' weak in themſelves, yet produce the Effect as well as the ſtronger, which are much dearer: But amongſt the latter he prefers Vinegar, which being very plentiful in *France*, may be uſed with little Coſt. For you need only dip each Leaf into it, and take it out again immediately, leaving it afterwards in ſome moiſt Place, and it will be ſcaled in eight and forty Hours, if you take care to repeat this 3 or 4 Times in a Day. The ſcaling will ſtill be more expeditious, if you diſſolve a little Sal-armoniack in the Vinegar, a Pound or two to a Puncheon; for as the Vinegar diſſolves Iron well, ſo Sal-armoniack, as juſt obſerved, ruſts it ſooner than any other Salt: But this muſt be uſed very moderately, and the Leaf muſt be left to ſteep in clean Water to diſſolve any Particles of it that may ſtick to its Surface, which may otherwiſe make it ruſt after it is tinned. If you ſcale with Vinegar, and want to do it at a leſs Expence, you need only plunge the Leaves once or twice at fartheſt, and when the Vinegar is dried upon the Surface, ſprinkle it with Water; or dip them into it, and take them out immediately. There are ſeveral other Ways of making Iron ruſt, as keeping it in a moiſt Cellar, expoſing it to the Dew, ſprinkling

it with ſimple Water, ſeveral Times in a Day, which will ſtill act quicker by diſſolving Sal-armoniack in it. In thoſe Countries where the Pyrites is common, the Vitriolick Waters will ſcale them ſoon enough, which are almoſt as cheap as common Water: You need only heap the Pyrites together, and leaving them to moulder in the Air, make afterwards a Lixivium with them and common Water, which Lie will have the deſired Effect: But as the Leaves of Iron are ſenſibly much eaſier cleanſed on one Side than the other, the bad Side rarely taking the brilliant Poliſh in the tinning, but having always ſome Spots, which proceeds in that in the beating one Side is more expoſed to the Action of the Hammer, and is therefore better plained, the Author again adviſes not to ſteep them, but only to moiſten them, in order to make them ruſt, whereby you need moiſten that Side only that wants it moſt: Whereas if you ſteep them, as the bad Side will take double or triple the Time of the other, the acid Menſtruum will diſſolve the Surface, and occaſion a Loſs of Iron. He next gives two Cautions neceſſary to be followed: the firſt is in the Management of the Plates before they come to be prepared; which is in the beating of them, to change the Place of each in its Turn, that every one may receive the immediate Action of the Hammer, otherwiſe they will not extend equally: the ſecond is to ſteep them in Clay or Fuller's earth tempered with Water before you heat them, to prevent their ſoldering with one another. He then cloſes this Part of the Operation with remarking that whatſoever of theſe Methods are pitched upon, whether the old one, of which he has learnt the Secret, or any of the new, which he has here ſhewn, it is abſolutely neceſſary after the Plates

are ſufficiently ſcaled, to ſcour them with Sand, and when there remains no more black Spots upon their Surface, to throw them into Water to prevent their ruſting again, and leave them in it till the Inſtant you would tin them, or in the Term of Art, blanch them. This he obſerves is the very Object of the whole Art, and is kept as much a Secret by the *Blancher*, as the acid eroding Menſtruum is by the *Scaler*: But the Manner of doing it is thus. They flux the Tin in a large iron Crucible, which has the Figure of a broken Pyramid with four Faces, of which the two oppoſite ones are leſs than the two others. This Crucible they heat only from below, its upper Border being luted in the Furnace quite round. The Crucible is always deeper than the Plates which are to be tinned are long, which they always put in downright, and the Tin ought to ſwim over them. For this Purpoſe Artificers of different Trades prepare the Plates in different Manners, which are all exceptionable: But the *Germans* he perceived made uſe of no Preparation whatſoever, except putting the ſcoured Plates into clean Water, as juſt remarked; but when the Tin is melted in the Crucible, they cover it with a Layer of a Sort of Suet, an Inch or two thick, through which the Plate muſt paſs before it comes to the Tin: The firſt Uſe of which is to keep the Tin from burning, and if any Part ſhould take Fire, as the Suet will ſoon moiſten it, to reduce it to its natural State again. This Suet is compounded, as the Blanchers ſay, and is of a black Colour, which the Author thought might be given it with Soot or the Smoak of a Chimney, only to ſpread a Myſtery over their Work; but he found it true ſo far, that common unprepared Suet was not ſufficient: For after ſeveral Attempts, there

was always ſomething wanting to render the Succeſs of the Operation certain. The whole Secret then of Blanching lies entirely in the Preparation of this Suet: And this he at laſt diſcovered to conſiſt only in firſt frying and burning it; which not only gives it the Colour, but puts it into a Condition to give the Iron a Diſpoſition to be tinned, which it does ſurpriſingly. The Tin itſelf ought to have a certain Degree of Heat; for if it is not hot enough it will not ſtick to the Iron; if it is too hot, it will cover it with too thin a Coat, and the Plates will have ſeveral Colours, as a Mixture of red, blue, and yellow, and the whole appear of a villainous yellow Caſt. To prevent this, by knowing when the Tin has a proper Degree of Heat, they might firſt make an Eſſay with ſmall Pieces of the ſcaled Plates, and they would learn from them when the Tin is in proper Order: But generally ſpeaking, they dip the Plates into Tin that is more or leſs hot, according to the Thickneſs they would have the Coat to be of. Some Plates they only give one Layer to, and theſe they plunge into Tin, that has a leſſer Degree of Heat than that into which they plunge thoſe Plates which they would have take two Layers; as alſo when they give theſe the ſecond Layer, they put them into Tin that has not ſo great a Degree of Heat, as that into which they were put the firſt Time: Beſides which, it is to be obſerved, that the Tin, which is to give the ſecond Coat, ought to be freſh covered with Suet, but only with the common Sort without Preparation; for melted Tin is ſufficiently diſpoſed to attach it ſelf to ſolid Tin; and in this Caſe it is to tin itſelf, to which the new Tin is to be joined. As to the Choice of the Tin, the Manner of making it is as bright as poſſible, with a Num-

ber